Electric HOME HEATING

COOPERATIVE EXTENSION SERVICE—THE OHIO STATE UNIVERSITY

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Heating homes by electricity is gaining in acceptance and adoption by home owners and builders not only in Ohio but throughout the United States. The use of electric energy to provide supplemental heat for the bath, laundry, workshop, and other hard-to-heat areas of the home has been common practice for many years. But the installation of completely electric home heating systems did not occur in significant numbers until the late 1940's.

One measure of the increasing popularity of electric heating is the increase in number of electrically heated homes during the period 1962-67. The figures cited have been compiled from report data gathered from several private, institutional, and governmental agencies.

Number of Electrically Heated Homes

	Ohio	U.S.
1962	12,000	600,000
1967	43,000	3,000,000

These statistics are more significant because they represent growth of home heating systems which have higher energy costs than competing fuel systems.

There are two basic types of electric home heating systems — heat pump and resistance. The heat pump is a mechanical, reversible-refrigeration, system which provides year around comfort conditioning. The adequate explanation of the operating characteristics, advantages, and disadvantages of heat pump systems is beyond the scope of this publication. The majority of electric home heating systems are of the resistance type. This discussion is therefore limited to the principles of operation, advantages, disadvantages, recommendations for installation, and predictions of future growth of resistance electric home heating systems.

Resistance Electric Home Heating

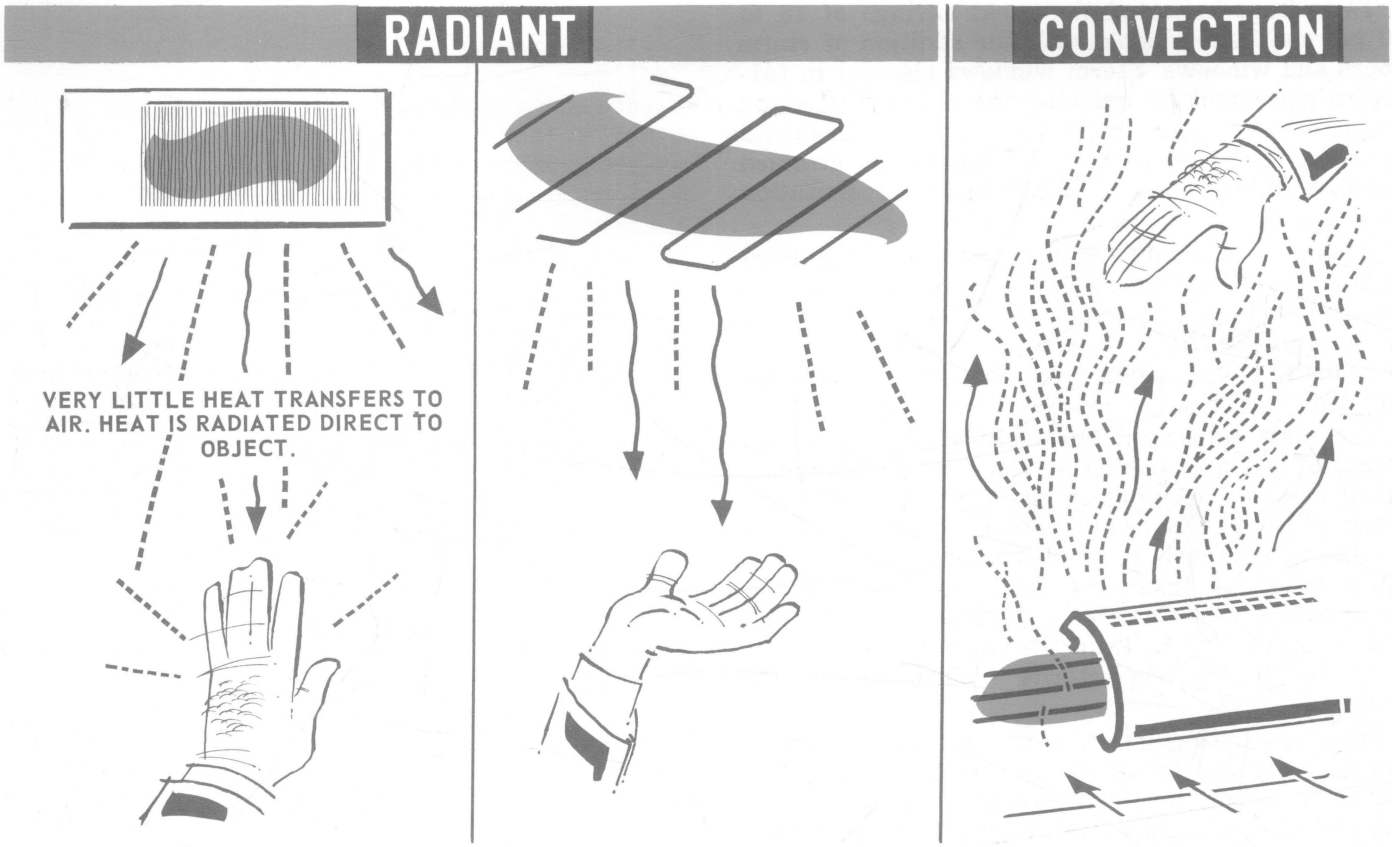
PRINCIPLE OF OPERATION: The principle of operation of resistance electric heating is very simple. Every electrical conductor offers some resistance to the electrical current that flows through that conductor. This resistance causes energy to be given off in the form of heat. By careful selection and combination of material and size of conductor, the heat output of that conductor can be accurately determined. Most domestic electric heating appliances, such as the range, water heater and clothes dryer, involve this resistance heating principle.

TYPES OF HEATING SYSTEMS: There are two types of resistance electric home heating systems—*Convection* and *radiant*. The difference between these two types is the method by which heat is transferred from the heating unit. In the convection system, air is warmed in passing over the heating element and then gives up this heat upon contact with cooler objects or cooler air.

Convection electric heating is available in several forms. Baseboard is the most popular form of convection heating system. Other forms of convection systems feature wall-mounted units, central electric furnaces and floor furnaces. A choice of natural or forced air circulation is available with most convection systems.

Radiant electric heating operates on the principle that a warm surface will transmit radiant energy directly to a cooler surface. This heat transfer occurs without much warming of the air between the two surfaces. The sun and the infra-red lamp are examples of radiant heating.

Several forms of radiant electric heating are available. Radiant glass and cone-element wall units were among the earliest forms of electric home heating. The radiant ceiling type, in which heating



cable is embedded in the ceiling plaster, is now the most popular of radiant heating systems. Infra-red heating units, particularly of the quartz lamp type, show much promise as an instant heat source for occasional or supplemental heat in such areas as the basement and laundry.

CONTROL: Temperature control with most resistance electric home heating systems is accomplished on the individual room basis. Each room, or living area, has its individual heating system and thermostatic control. Thus, it is possible and practical to maintain a different temperature in each room of the home.

Thermostatic controls are available in either the line voltage or low-voltage transformer types. Both controls give very satisfactory temperature regulation.

INSULATION: Thermal insulation is a valuable feature of any home comfort-conditioning system regardless of type. It is essential to electric home heating systems.

The principle benefit from home insulation is the reduction of heat loss (or gain) which reduces heating (or cooling) costs. Other direct benefits of home insulation are:

1. Less heating or cooling capacity required of system—lower investment in equipment.
2. Elimination of radical temperature changes within home due to rapid outdoor temperature changes.
3. Reduction in noise level within home.
4. Warmer indoor surfaces — less frequent and easier cleaning.

VAPOR BARRIERS: A vapor barrier is recommended to prevent the transfer of moisture through the room surfaces into unventilated spaces such as an insulated sidewall. A vapor barrier is always recommended for sidewalls and should always be applied to the warm side of the wall to cover the framing and insulation.

Vapor barriers are not so commonly applied to insulated ceilings but are certainly recommended where ventilation is restricted on the cold side of the insulation. A floored attic is an excellent example of such a situation.

The following insulation recommendations have been established as the minimum standard for electrically heated homes. The **"R" number**, which measures the installed resistance provided by the insulation to the transmission of heat, is printed on the insulation package.

Minimum value for ceilings is R = 19; exterior walls, R = 13; and floors, R = 11. These "R" values can usually be obtained with 6" insulation in ceiling, 3⅝" in exterior walls, and 2" under floors over unheated spaces. Two inches of perimeter-type rigid insulation should be used with slab floors.

Storm doors and windows are also recommended for the electrically-heated home. The insulating effect provided by storm doors and windows is twofold. The air space trapped between the window and the storm sash reduces the direct transmission of heat through the glass. Probably the greatest heating cost savings provided by storm doors and windows, however, is the decrease in the rate of infiltration of cold air into the home.

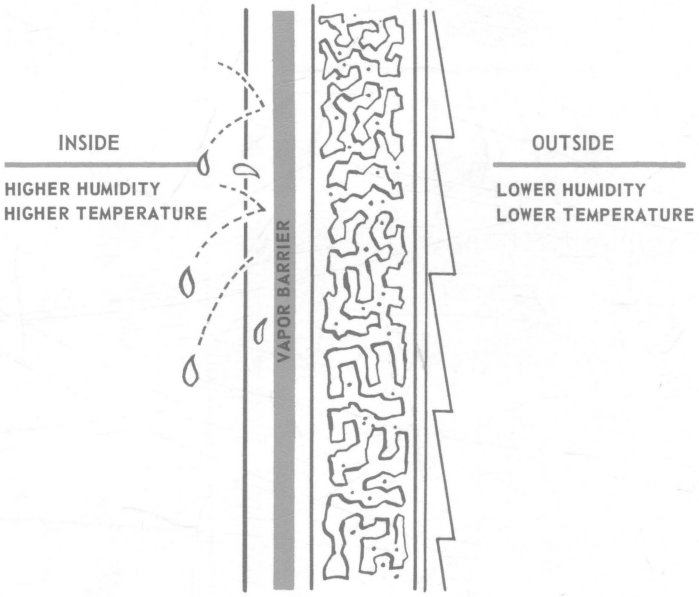
Tests have indicated that heat savings of 15 to 20 per cent are possible with the addition of storm doors and windows. Storm windows also aid in furniture placement by reducing the chilling effect on people seated near windows. A more healthful moisture balance within the home is attained through reduction, or elimination, of condensation on windows.

In new homes this vapor barrier can be applied in two ways. Batt or blanket type insulations have an asphalt-impregnated or aluminum foil facing which provides vapor barrier protection. Polyethylene plastic film is also a very popular vapor barrier material.

The most important consideration in the application of a vapor barrier is that it be continuous. Small holes or openings in the vapor barrier allow moisture to pass through and concentrate in the insulating material. It is important that workmen other than the insulating contractor respect the value of the vapor barrier and not damage it after it is in place. Any holes in the vapor barrier should be sealed before the interior wall materials are applied.

For the existing home, vapor barrier protection can be obtained by applying the following paint materials to the interior surfaces of exterior walls and ceilings: aluminum paint with a spar-varnish vehicle, emulsion paints, primer sealer plus enamel, and rubber-resin lacquer paints. At least two coats should be applied.

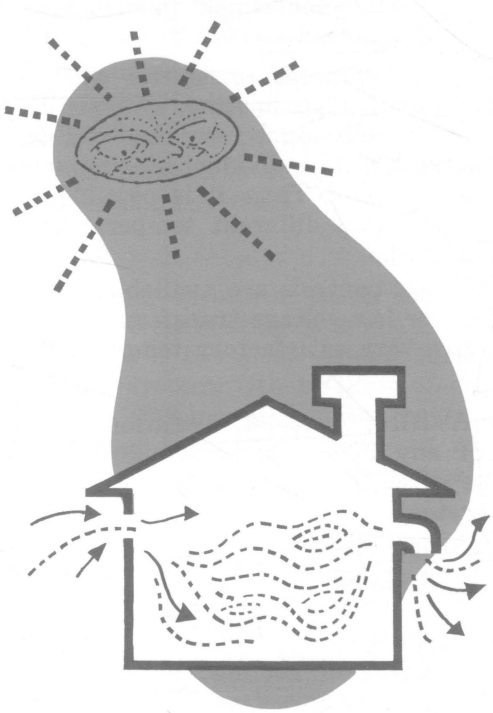
Vapor barriers should also be applied on the ground beneath slab floors and in crawl space areas to prevent the movement of ground moisture into the home. Polyethylene film and 55-pound roll roofing are both adequate. The edges of the roofing should be lapped at least two inches to provide a good seal.



Ventilation

A positive ventilation system should be made a "*must*" feature of any fully-insulated home regardless of the heating system used in that home. The "sealing" of the home with insulation and vapor barriers for efficient heating reduces the rate of air infiltration and displacement. Unfavorable moisture balance within the home is a possible problem of the fully-insulated home.

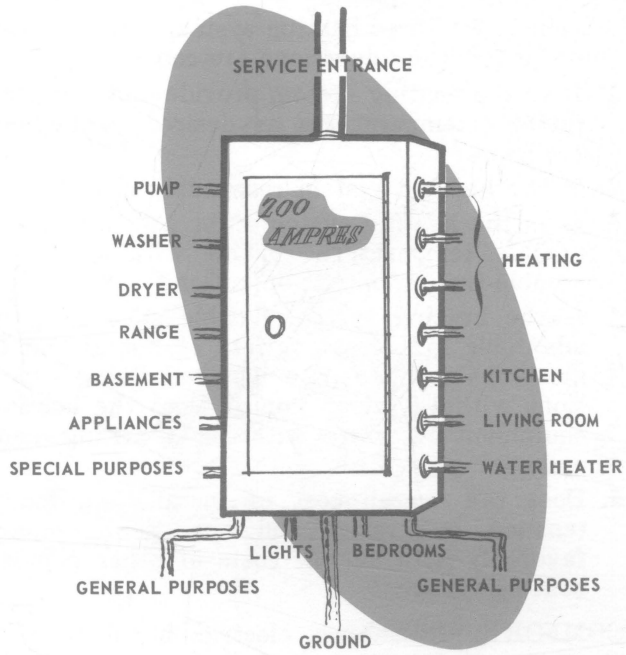
These problems can, in most cases, be eliminated by ventilation. It is, therefore, strongly recommended that ventilating fans for the kitchen, bath, and laundry be made an integral feature of the electric home heating system. Air should be drawn in from outdoors and exhausted outdoors. A combination manual and automatic humidistat control is recommended. The cost of installation and operation of such low-volume ventilating systems is very small when compared with the comfort benefits they produce.



Adequate Wiring

Another essential feature of electric home heating is adequate wiring. The heat output of resistance heating units is designed for specific operating voltage. A 10 per cent drop in voltage results in 20 per cent reduction in heat output and a thoroughly unsatisfactory operation. Service entrance capacity should be adequate. Heating circuit wiring should be designed and installed to meet the anticipated load.

All heating equipment and wiring should meet or exceed the specifications of the National Electric Code. A competent local electrician should install the wiring. In many Ohio communities, electricians are also electric heating contractors.



Basement Heating

If the basement is to be used as a recreation area or other addition to the living area, it must be insulated to give reasonable operating costs. If the basement is used primarily as a storage area with only occasional use for laundry or workshop, radiant or forced-air electric heaters may be used to provide heat only during the time this area is used. Certain areas of the basement can be partitioned, insulated, and heated so as to provide a constant, comfortable temperature for a recreation room or workshop.

Electric Heating for Existent Homes

We have discussed the application of electric heating largely from the view of its installation in new home construction. This might lead the reader to believe that electric heating is not adaptable to existent homes. This is certainly not the situation.

There are more than 6,500 electrically heated homes in Ohio in which the electric heating systems have replaced fuel-fired systems. Electric heating is readily adaptable to the existent home. The recommendation for insulation is exactly the same as for new construction. The difficulty of applying the insulation is, however, increased somewhat in the existent home. In this regard, it is important that the insulating contractor have considerable experience so that a uniform insulation treatment is obtained. Convection baseboard systems are most popular in converting existent homes to electric heating.

Evaluation of Electric Heating

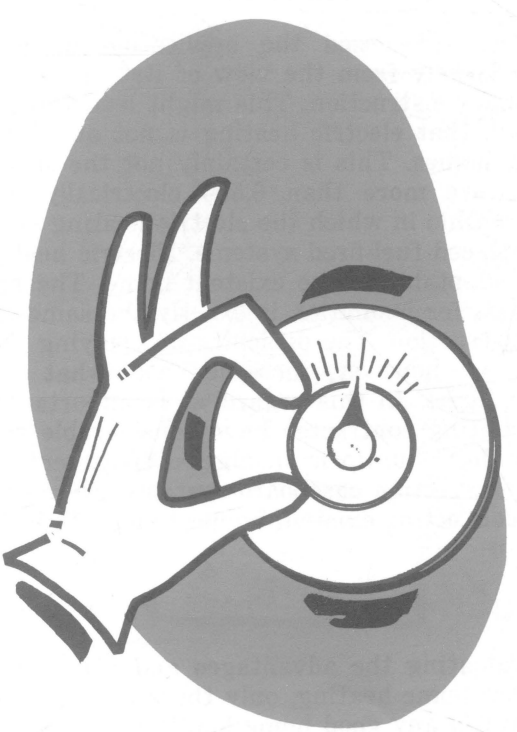
In evaluating the advantages and disadvantages of electric home heating, only those qualities which we expect in any good home heating system will be discussed. There are undoubtedly other features which might be of significant interest to the indi-

vidual homeowner, but the basic features included in the following evaluation should be of almost universal interest and importance. It should also be obvious that this evaluation must include a comparison of electric heating with the more common and familiar fuel-fired heating systems. In this evaluation the following questions are considered:

1. Does the heating system provide uniform comfortable temperatures as desired throughout the home?
2. Is the heating system reasonably clean?
3. Does the heating system offer convenient and flexible temperature control with relatively trouble-free automatic operation?
4. Is the heating system flexible enough to be adaptable to a great variety of homes and to meet changes in space use and living conditions within a given home? Does the heating equipment interfere with room arrangement and use?
5. Does the overall cost of installation, maintenance, ownership, and operation compare favorably with similar costs of other popular heating systems?

COMFORT: Resistance electric home heating systems provide excellent comfort. Heating capacity is calculated and installed to meet the heat demands of individual rooms or areas within the home. Independent thermostatic control permits a choice of temperature for each room within the home. Very good temperature regulation is obtained with thermostatic controls of 1 to 2 degrees operating differential.

Any heating system, such as resistance electric heating, that moves a limited volume of air within a given room or area of the home will produce few floor drafts. This contributes greatly to heating comfort.



CLEANLINESS: Users of electric home heating are almost unanimous in their praise of its cleanliness. This is because electric heating systems move less air at lower speeds than do warm-air central heating systems. Thus, less dirt is picked up and deposited on furniture, ceilings, and walls. Cleaning is not only less frequent, but is also much easier.

CONVENIENCE: Convenience has always been a distinguishing characteristic of electrical equipment. Electric home heating is no exception. Equipment is simple in construction and is readily adaptable to a great variety of furniture and equipment arrangements. Controls are easily operated and are relatively trouble-free due to simple design and construction.

FLEXIBILITY: Resistance electric heating systems are as flexible as the wiring which supplies the energy to the heating units. This feature, plus the variety of electric heating systems, makes resistance electric heating systems more flexible than most fuel-fired heating systems.

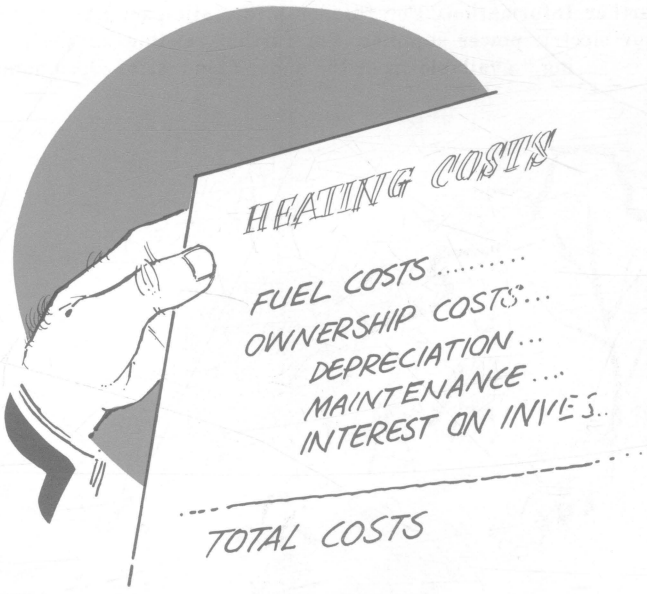
The flexibility of electric heating is a distinct advantage to the home builder and/or architect in designing homes in terms of space savings and the accommodation of unusual design features and treatments. Electric heating systems are easily adaptable to remodeling changes.

MAINTENANCE: Difficulties and costs of maintaining resistance electric home heating systems are considerably less than with central fuel-fired systems. Most electric heating systems involve simple design and construction of equipment; few, if any, moving parts; no filters to change or replace; and no furnaces, flues, or ducts to clean. Electric heating equipment, properly installed, will give dependable service with little maintenance attention and cost.

INSTALLATION COST: In general, the installation cost of a complete resistance electric home heating system—including heating equipment, controls, increased electrical service-entrance capacity, plus a complete insulation treatment of the home—is less than the cost of installation of a comparable fuel-fired central heating system. You should remember, however, that installation costs vary widely in even a relatively small area. It is always wise to examine carefully each heating contractor's or dealer's proposal to know exactly what equipment he will include, how he will install it, and to what extent the contractor will guarantee performance of the system. The services of a competent and reputable local heating installer can help you gain satisfaction from your home heating system.

Cost of Heating

The annual cost of a home heating system is the sum of fixed and variable costs. Practically all the variable cost is energy cost, and, for Ohio, electric heating systems have a greater energy cost than do the competitive fuel systems. Fixed, or "ownership," costs consist of depreciation, interest on investment, repairs, taxes, and insurance. These costs are generally lower for electric heating systems and thereby reduce the annual cost difference between electric and fuel heating systems.



The Future of Electric Home Heating

The historical trend of home heating has been for newer, and apparently more advantageous, heating methods to gradually replace existent systems. The replacement of coal systems by gas and oil systems is typical of this trend. It is significant to note that this change progressed rapidly at a time when coal systems operated at a lower fuel cost. Electric home heating has several advantages, such as low installa-

tion cost, cleanliness, low maintenance cost, and individual room temperature control, which would support increased popularity.

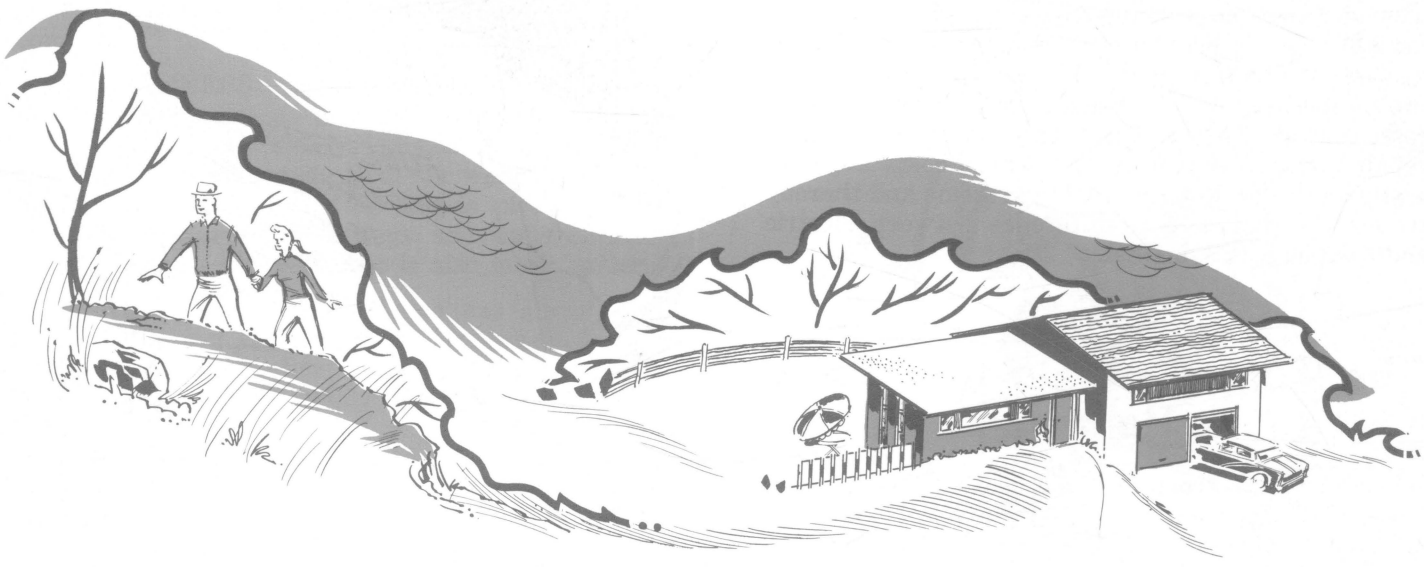
Recent surveys of consumer preference in home heating systems and studies by Johns Hopkins University and the U.S. Federal Power Commission indicate a potential of 18 to 19 million electrically heated residential units by 1980. Several factors may act to modify these predictions not least of which are the relative changes in electric rates and fuel costs. The Federal Power Commission has also forecast substantial decline in general electric rates — perhaps as great as 25% — by 1980. If these predictions are reasonably accurate, resistance electric heating may become one of the more popular home heating systems.

Common Sense Tips

If you are considering electric heating for your home, the following step-by-step approach should help assure you greater satisfaction with your heating system.

1. **Contact the heating representative of your local electric power supplier.** Ohio power suppliers are definitely interested in electric home heating and will, in most cases, assist in planning your heating system. This contact will also alert your power supplier to make certain your electric service facilities are large enough to handle your heating load.
2. **Discuss electric heating with several users.** Visit electrically heated home which are using several types of systems, if possible. Your power supplier may be able to provide you with the names of several users.
3. **Inform your architect or home builders of your interest in electric heating.** This should be done early in the home planning stage. Most Ohio power suppliers offer consultant service to architects and home builders in planning for electric heating.
4. **Know what you are getting in your electric heating installation.** Check carefully for materials and installation specifications. Don't skimp on the essentials of insulation, adequate wiring, and ventilation. The trend in Ohio is toward the inclusion of all these essential elements in a "package" installation proposal. This eliminates considerable confusion and misunderstanding that might arise in dealing with several sub-contractors.
5. **Employ reputable local installers.** Your power suppliers and satisfied electric heating users in your area are excellent reference sources.

Further Information: For further information on heating homes electrically, consult the electric heating representative of your electric power supplier. For further reading on the subject, consult USDA, REA, Bulletin 142-1, "Electric House Heating," available from the superintendent of Documents, U. S. Government Printing Office, Washington, D.C. 20025.



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